LOCATION-AWARE FITNESS TRAINING DEVICE, METHODS, AND PROGRAM PRODUCTS THAT SUPPORT REAL-TIME INTERACTIVE COMMUNICATION AND AUTOMATED ROUTE GENERATION

PRIORITY CLAIM AND RELATED APPLICATIONS

[0001] The present application claims priority from U.S. Patent Application Serial No. 60/440,519, filed January 16, 2003. The present application is also related to U.S. Patent Application Serial No. 60/421,277. The foregoing applications are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

1. Technical Field:

[0002] The present invention relates in general to location-aware electronic devices, and in particular, to apparatus, methods, and program products facilitating the routing, scheduling, and real-time monitoring of outdoor activities, such as human fitness activities.

2. Description of the Related Art:

[0003] As Global Positioning System (GPS) technology has matured, location-aware electronics have been integrated into a number of different mobile platforms, such as automobiles, mobile telephones, two-way radios, and hand-held GPS receivers, in order to provide location-based information. U.S. Patent No. 6,013,007 to Root et al., which is incorporated herein by reference, discloses that a GPS receiver may additionally be implemented within an athlete's portable performance monitor to enable the performance monitor to record and to present the athlete with accurate performance information, such as distance traveled and pace.

SUMMARY OF THE INVENTION

[0004] While it is useful to leverage location-aware electronics to apprise an athlete of accurate performance information, the present invention recognizes that conventional portable GPS-enabled electronic devices suffer from a number of shortcomings, including the following:

(1) Conventional portable GPS-enabled electronic devices do not support automated two-way data communication;

(2) Conventional portable GPS-enabled devices do not permit a remote trainer or other user to easily monitor substantially real-time performance information of a human user (e.g., athlete) equipped with a portable GPS-enabled device or to communicate with the human user in real-time;

(3) Conventional portable GPS-enabled devices do not have an associated user interface that permits a user to easily generate, select, and schedule routes to be traversed, for example, in the course of a human fitness activity; and

(4) Conventional portable GPS-enabled devices do not have an associated user interface that permits a user to graphically and intuitive view, annotate and share location-specific route, performance and environmental information.

[0005] These and other shortcomings in the art are addressed and overcome by the present invention. In one embodiment, the present invention provides a portable fitness device including a global positioning system (GPS) receiver that receives GPS signals, a wireless wide-area network transmitter supporting communication over-the-air to a wireless communication network, and a processing unit coupled to the GPS receiver and the wireless wide-area network transmitter. The processing unit receives the time-stamped waypoints from the GPS receiver and determines athletic performance information and route information from the time-stamped waypoints. The processing unit further outputs at least one of the athletic performance information and the route information to the wireless communication network during a human fitness activity via the wireless wide-area network transmitter.

[0006] In other embodiment, the present invention includes a computer-based method supporting user route determination. According to the method, the computer, for example, a

server computer system executing a route generation module, receives at least one route criterion including at least one of route length and route duration. In response to receipt of the at least one route criterion, the computer system automatically generates one or more routes satisfying the at least one route criterion for user selection, where each such route represents a physical path that may be traversed by a human during a fitness activity. The routes are thereafter presented to a user for selection. In response to user selection of at least one route, the computer transmits information regarding the route to a portable fitness device, for example, via a wireless wide area network.

[0007] All objects, features, and advantages of the present invention will become apparent in the following detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The novel features believed characteristic of the invention are set forth in the appended claims. However, the invention, as well as a preferred mode of use, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

[0009] Figure 1 is a schematic diagram of an exemplary environment in which the present invention may be practiced;

[0010] Figure 2A is a schematic block diagram of an illustrative portable fitness device in accordance with the present invention;

[0011] Figure 2B is a layer diagram of an exemplary software configuration of a portable fitness device in accordance with the present invention;

[0012] Figure 3 is a layer diagram of an illustrative software configuration of a server computer system providing an automated web-based route generation, route journaling and route visualization service in accordance with the present invention;

[0013] Figure 4A depicts an exemplary graphical user interface of a route wizard through which a remote user may build a route, search for a route within a route database, and select routes within a predetermined training plan;

[0014] Figure 4B illustrates an exemplary route wizard graphical user interface through which a user may enter parameters and attributes of a new route;

[0015] Figure 4C depicts an exemplary route wizard graphical user interface through which a user may search a route database for an existing route;

[0016] Figure 4D illustrates an exemplary route wizard graphical user interface that presents a navigable geographical map populated with graphical indications of locations for which preexisting maps are stored within the route database;

[0017] Figure 4E depicts an exemplary route wizard graphical user interface within which a user may identify a selected route for detailed viewing;

[0018] Figure 4F depicts an exemplary route wizard graphical user interface that presents a detailed description of a route and permits the user to upload the route to a portable fitness device;

[0019] Figure 5A illustrates an exemplary graphical user interface of a training journal through which a user may view routes traversed with a portable fitness device in accordance with the present invention;

[0020] Figure 5B depicts an exemplary graphical user interface of a training journal entry detailing a particular route traversed with a portable fitness device in accordance with the present invention; and

[0021] Figure 5C illustrates an exemplary graphical user interface of a training journal entry showing a route view in which multiple route and/or performance parameters are concurrently graphically presented in a banded format along a route path.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENT

[0022] With reference now to the figures, and in particular with reference to **Figure 1,** there is depicted an exemplary embodiment of an environment in which the methods, systems, and program products of the present invention may advantageously be practiced. In particular, **Figure 1** illustrates an environment **10** in which a location-aware portable fitness device **12** is utilized by an athlete **14** while engaged in a fitness activity, such as running, cycling, hiking, skiing, etc.

[0023] As shown, environment **10** includes a constellation of earth-orbiting global positioning system (GPS) satellites **20**. As is known in the art, GPS satellites **20** continuously emit GPS signals **22,** which enable GPS-equipped devices, such as portable fitness device **12,** to continuously determine their position, velocity, and bearing as long as a sufficient number of GPS satellites **20** can be acquired.

[0024] Environment **10** further includes a wireless wide-area network (WAN) communication system including a plurality of geographically distributed cellular telephone towers **30** and base station systems (BSS) **32** (only one of each is illustrated for simplicity). Cellular telephone tower **30** includes one or more antennae **34** supporting long range two-way radio frequency communication with mobile telephones and other wireless devices, such as portable fitness device **12**. The radio frequency communication between antennae **34** and portable fitness device **12** may utilize radio frequency signals **36** conforming to any known or future developed wireless protocol, for example, CDMA, GSM, EDGE, 3G, etc. The information transmitted over-the-air by BSS **32** and cellular communication tower **30** to portable fitness device **12** may be further transmitted to or received from one or more additional circuit-switched or packet-switched communication networks, including, for example, the Internet **40**.

[0025] As is well known to those skilled in the art, Internet **40** is a worldwide collection of servers, routers, switches and transmission lines that employ the Internet Protocol (IP) to communicate data. For example, Internet **40** may be employed to communicate data between

any of server computer system **42**, client computer system **44**, and portable fitness device **12**. For example, as described further below, Internet **40** may be utilized to communicate to portable fitness device **12** route information from a route database **52** stored within data storage **50** associated with server computer system **42**. Similarly, portable fitness device **12** may transmit route and performance information to server computer system **42** for storage in training journal database **54** via Internet **40**, BSS **32**, and cellular communication tower **30**. In addition, a user stationed at a remote client computer system **44**, for example, athlete **14** or a remote trainer, may access real-time or historical performance information regarding the training of athlete **14** via server computer system **42** and Internet **40**.

[0026] Referring now to **Figure 2A**, there is illustrated a high-level block diagram of an exemplary implementation of portable training device **12** in accordance with the present invention. As illustrated, portable training device **12** includes a central processing unit (CPU) **60** that controls the operation of portable fitness device **12** in accordance with client software **154** described further below with respect to **Figure 2B**. As shown, CPU **60** is coupled, either directly or indirectly to a variety of different components within portable fitness device **12**. For example, portable fitness device **12** includes an internal memory device **62** for storing the client software, as well as various route, performance and environmental information regarding a training activity of athlete **14**. The storage provided by internal memory device **62** may be further augmented by a removable storage medium inserted within removable memory slot **64** and/or dedicated audio storage **66** for storing audio data. The audio data may include, for example, music tracks encoded in MP3 format, synthesized human speech tracks, voice annotations by athlete **14** recorded via an internal or external microphone **68**, as well as other audio data.

[0027] In addition to microphone **68**, portable fitness device **12** may include a number of other input/output (I/O) devices. For example, portable fitness device **12** may include one or more manually manipulable input buttons **80** that permit athlete **14** to annotate a route while athlete **14** is traversing the route and/or to enter desired settings of portable fitness device **12**. Portable fitness device **12** may also include a speaker **82** and display **84** through which portable fitness

device **12** may present real-time performance information (e.g., elapsed distance, elapsed time, pace, distance to go, heart rate, etc.), turn-by-turn directions, real-time remote training recommendations, and other information in either an audio or visual format.

[0028] Portable fitness device **12** is equipped with a power supply **90** that powers CPU **60** and the other components of portable fitness device **12**. Power supply **90** includes a battery and may further have an associated power port **92** through which the battery may be charged from an AC power source. Alternatively, the battery within power supply **90** may be charged utilizing a wireless inductive charging device, as is known in the art.

[0029] Portable fitness device **12** further includes a GPS receiver **100** and associated GPS antenna **102** that receive GPS signals **22** from GPS satellites **20**. GPS receiver **100** processes GPS signals **22** to present to CPU **60** time-stamped waypoints, which include at least a time, a latitude, and a longitude. If at least four GPS satellites **20** have been acquired, the time-stamped waypoints presented to CPU **60** by GPS receiver **100** preferably further include an elevation. As discussed further below, the time and position information supplied by GPS receiver **100** is utilized by client software **154** running on CPU **60** to build a record of a route traversed by athlete **14** and to determine performance information (e.g., elapsed distance, elapsed time, pace, distance to go, heart rate, etc.) regarding the athlete's traversal of the route.

[0030] Portable training device **12** supports two-way wireless WAN communication with cellular telephone tower **30** with WAN wireless transceiver **104** and its associated antenna **106**. As known to those skilled in the art, WAN wireless transceiver **104** includes a receiver for receiving radio frequency signals **36** and a transmitter for transmitting radio frequency signals **36**. As discussed in greater detail below, radio frequency signals **36** may include route information transmitted to portable fitness device **12**, route and performance information transmitted from portable fitness device **12**, settings for portable fitness device **12**, and one or two-way voice communication (e.g., a voice conversation between athlete **14** and a remote trainer stationed at remote client computer **44**). The data sent and received by WAN wireless transceiver **104** may alternatively be communicated via an optional data port **108**, which may

employ short range wired or wireless communication (e.g., RS-232 or infrared).

[0031] In order to support communication with other electronics within close range, portable fitness device **12** may be further equipped with one or more local wireless interface(s) **110** and associated antennae **112**. For example, local wireless interface(s) may include interfaces for 802.11x, Bluetooth, 900mHz communication or the like. Utilizing such technologies, portable fitness device **12** may communicate with or sense data from a heart rate monitor **120**, headphones **122**, shoes **124**, and a watch **126** worn by athlete **14** during a fitness activity. In this manner, portable fitness device **12** may gather information regarding athlete **14**, such as his/her heart rate and body temperature, and if the athlete's shoes **124** are equipped with an RFID tag, the shoes **124** worn during the fitness activity. Portable fitness device **12** may similarly present to the user performance, directional and training information via watch **126** and headphones **122**.

[0032] Of course, in alternative embodiments, portable fitness device **12** may sense or communicate with particular devices utilizing wired or wireless interfaces. For example, microphone **68** may alternatively be incorporated within wireless headphones **122**, and heart rate monitor **120** may alternatively be coupled to CPU **60** via a wired interface. Thus, those skilled in the art will appreciate from the block diagram provided in **Figure 2A**, that any number of internal or external devices and sensors, such as temperature and barometric pressure sensor **130**, may be coupled to CPU **60** via either wired or wireless interfaces. In this manner, client software running on CPU **60** may associate with the time and position information provided by GPS receiver **100** various data of interest regarding athlete **14**, his/her environment and the route being traversed. The data may be stored locally by portable fitness device **12**, for example, within internal memory device **62**, or transmitted over-the-air by WAN wireless transceiver **104**, possibly in real time.

[0033] With reference now to **Figure 2B**, there is illustrated a layer diagram of an exemplary software configuration of portable fitness device **12** in accordance with one embodiment of the present invention. As illustrated, the software configuration of portable fitness device **12** includes at a lowest level an operating system (OS) **150** that provides a collection of services,

such as thread scheduling, memory management, interrupts, etc., that may be accessed by higher-level software. Running on top of operating system **150** is a runtime environment **152**, such as one of the JAVA or BREW runtime environments. Finally, the software configuration of portable fitness device **12** includes a portable fitness device client **154** running on top of runtime environment **152**. Portable fitness device client **154** may be downloaded to portable fitness device **12** over-the-air, for example, via the wireless WAN and WAN wireless transceiver **104**.

[0034] As illustrated, portable fitness device client **154** comprises a number of individual modules, each performing a function of portable fitness device **12**. Those skilled in the art will appreciate that the illustrated modules are illustrative rather than exhaustive, and that portable fitness device client **154** may include additional or alternative modules to support or extend the functionality of portable fitness device **12**.

[0035] As shown in **Figure 2B**, the modules within portable fitness device client **154** preferably include a number of reader modules **160-166**. GPS reader **160** receives from GPS receiver **100** time-stamped waypoints including at least time, latitude and longitude information, and, depending upon implementation and the number of GPS satellites **20** from which GPS signals **22** were received, elevation and error information. Utilizing the time-stamped waypoints received from GPS receiver **100**, GPS reader **160** calculates performance and route information for athlete **14**. For example, GPS reader **160** may determines the start time at which a route was begun, an elapsed time, an elapsed distance, distance remaining in the route, elevation change, average elevation, current pace, average pace, bearing, etc.

[0036] The remainder of readers **160-166**, for example, heart rate reader **162** and annotation reader **164**, similarly obtain input data and associate the input data with a corresponding time-stamped waypoint obtained by GPS reader **160**. Readers **162-166** may also perform additional calculations to determine instantaneous, differential or cumulative quantitative characterizations of the route, the performance of athlete **14** or of his/her environment. Thus, for example, heart rate reader **162** may obtain an instantaneous heart rate reading from heart rate monitor **120**,

associate that heart rate reading with the time-stamped waypoint obtained by GPS reader **160**, and calculate an average heart rate. Similarly, annotation reader **164** may store a route annotation entered by athlete **14** via input buttons **80** or microphone **18** with a time-stamped waypoint obtained by GPS reader **160**.

[0037] The data gathered and calculated by readers **160-166** are then parsed and formatted by formatter **170** into a predetermined data format that associates the performance and route data with a timestamp and geographical location. The particular data format employed by data formatter **170** is implementation-dependent, but is preferably compact to conserve the capacity of internal memory device **62** and the bandwidth of the communication link between portable training device **12** and the wireless WAN. Storage capacity and wireless communication bandwidth may further be conserved by applying a data compressor **172** to the formatted data produced by data formatter **170**.

[0038] After data obtained and calculated by readers **160-166** have been formatted by data formatter **170** and optionally compressed by data compressor **172**, the data are either stored within internal memory device **62** (or audio storage **66** or a removal memory loaded in removable memory slot **64**) or are transmitted over-the-air via WAN wireless transceiver **104**. Upload manager **174** and route and performance recorder **176** determine whether or not to upload and/or store data locally based upon one or more criteria, for example, whether WAN wireless transceiver **104** can acquire a connection to the wireless WAN, the available storage within internal memory device **62**, an indication of whether or not a remote user is tracking the training of athlete **14** in real-time, and/or other criteria. If, based upon these and/or other criteria, upload manager **174** decides to upload the formatted and compressed data, upload manager **174** outputs the data via WAN wireless transceiver **104** and antenna **106** to client computer system **44** and/or server computer system **42** utilizing radio frequency signals **36**. Data transmitted to client computer system **44** is typically graphically presented within a display device, and data transmitted to server computer system **42** is typically stored within training journal database **54**.

[0039] As noted above, portable training device **12** may alternatively receive data over-the-air

from the wireless WAN. In a preferred embodiment, the data received over-the-air from the wireless WAN may include route information transmitted by server computer system **42** from route database **52**, settings of portable fitness device **12** transmitted by server computer system **42** or client computer system **44**, and training recommendations transmitted from server computer system **42** or client computer system **44**. Route information, which may be identified as such, for example, by an XML header, is received, processed and stored by route storage manager **182**. The route information may be, for example, turn-by-turn directions keyed to particular geographical areas defined by a latitude and longitude range duple. By storing route information in this format, when GPS reader **160** obtains a time-stamped waypoint falling within a particular geographic area defined by a latitude and longitude range duple, audio presentation module **192** can present an audible instruction to athlete **14** via speaker **82** and/or headphones **122** to direct athlete **14** how to traverse a desired route.

[0040] Settings data, which may be identified as such, for example, by an XML header, is initially received, processed, and output by data decompressor **180** is then subsequently processed by settings manager **184**. For example, settings manager **184** may utilize settings data to update storage locations within internal memory device **62** governing particular aspects of the operation of portable training device **12**. In addition, based upon the received settings, settings manager **184** may notify upload manager **174** or route and performance recorder **176** to initiate upload or storage of route and performance information.

[0041] Training recommendations received, processed and output by data decompressor **180** are subsequently processed by training input manager **186**. These training recommendations preferably take the form of either voice data communicated by a human trainer utilizing, for example, a voice-over-IP (VoIP) connection to portable training device **12**, or a predetermined data command representing an audio message. In the former case, training input manager **186** exports the audio data directly to audio presentation module **192**, which, in turn, directly presents the audio data to athlete **14** via headphones **122** and/or speaker **82**. If, however, the training recommendation takes the form of a data command representing an audio message, training input manager **186** locates an audio track within audio storage **66** or internal memory device **62**

corresponding to the data command and presents the audio track to audio presentation module **192** for subsequent presentation to athlete **14**. In this manner, a remote trainer, who may be stationed at client computer system **44**, may provide training recommendations directly to athlete **14** in substantially real-time. And, if portable training device **12** is equipped with a microphone **68**, athlete **14** may similarly communicate audibly with the remote trainer (e.g., via VoIP) through the execution of annotation reader **164** data formatter **170**, data compressor **172** and upload manager **174**.

[0042] Audio presentation module **192** is also preferably equipped to present, in audio format, turn-by-turn directions correcting the course of an athlete **14** to return to a route if a turn is missed, as well as turn-by-turn directions providing the most direct return path to the starting point. Such turn-by-turn directions are preferably computed by server computer system **42** based upon real time location information received over-the-air from portable fitness device **12** and then transmitted to portable fitness device **12**, again utilizing over-the-air communication via the wireless WAN. Audio presentation module **192** may also be utilized to decode and present audio entertainment tracks, such as the MP3 files stored within audio storage **66**.

[0043] As further depicted in **Figure 2B**, portable fitness device client **154** includes a visual presentation module **190** that manages the presentation of route, performance and environmental information to athlete **14** via optional display **84** and/or the display of watch **126**. It should be noted, however, that it is presently preferred to present data of all types to athlete **14** during the course of a fitness activity in audio format so that the concentration and attention of athlete **14** is not diverted from training efforts.

[0044] Finally, route publication manager **194** of portable fitness device client **154** supports the sharing of routes between multiple portable fitness devices **12**, for example, utilizing the local wireless interface **110**, WAN wireless transceiver **104**, or data port **108**. In this manner, an athlete **14** can directly share selected routes (e.g., as identified utilizing input buttons **80**) to other athletes having compatible portable fitness devices **12**.

[0045] Referring now to **Figure 3**, there is depicted a layer diagram of an exemplary software configuration of server computer system **42** of **Figure 1** that, in accordance with the present invention, provides an automated web-based route generation, route journaling and route visualization service. The service may be restricted to users that have been issued login IDs and passwords, and may further be offered in exchange for a subscription fee.

[0046] As shown, at the lowest layer the software configuration of server computer system **42** includes an operating system (OS) **210**, which is preferably one of the commercially available operating systems, such as Windows, UNIX, LINUX, AIX, etc. OS **210** has an associated application programming interface (API) **212** though which middleware and application programs may access the services of OS **210**.

[0047] Running on top of OS **210** is a hypertext transport protocol (HTTP) server **214**, which, as is well known in the art, communicates data over Internet **40** utilizing HTTP. In particular, HTTP server **214** supports data communication with portable fitness device **12** and one or more remote client computers **44** utilizing HTTP. Communication with server computer system **42** may alternatively or additionally be conducted utilizing a sockets layer interface or other lower layer protocol running over IP.

[0048] In addition to HTTP server **214**, the application software of server computer system **42** includes a number of different modules supporting the client-side functionality provided by portable fitness device client **154**. In the depicted embodiment, these modules include a route generation and publication module **220**, a data recorder module **226**, and a visualization module **230**. Those skilled in the art will again appreciate that alternative or additional modules may be implemented within server computer system **42** in order to provide or extend the described or additional functionality.

[0049] Route generation and publication module **220** generates routes to be traversed by athletes **14** during fitness activities, stores the routes within route database **52** (**Figure 1**) for subsequent access, and downloads the routes to portable fitness devices **12**. In a preferred embodiment,

route generation and publication module **220** includes a route wizard **222**, which, as described below with respect to **Figure 4A-4F**, guides a user through a step-by-step process for generating routes having desired parameters and attributes. As shown in **Figure 3**, route generation and publication module **220** preferably accesses a local or remote map database **224** that stores street and/or trail information in association with at least latitude and longitude information, and preferably elevation information. Thus, given at least one terminal point (e.g., a starting point), route generation and publication module **220** is able to construct one or more routes having a desired length, elevation profile, and other parameters and attributes. Routes generated by route generation and publication module **220** are stored for subsequent access within route database **52**.

[0050] Once a particular route is scheduled by an athlete **14** as discussed further below, route generation and publication module **220** transforms the route into a sequence of turn-by-turn instructions and publishes the route to a portable fitness device **12** via HTTP server **214** and the wireless WAN. Because route generation and publication module **220** can obtain elevation information along a desired route directly from map database **224**, route generation and publication module **220** is also able to advantageously supply, in conjunction with a route, elevation information for the route. In this manner, the elevation information supplied by route generation and publication module **220** can assist or replace the elevation information provided by GPS receiver **100**. Thus, if less than four GPS satellites **20** are acquired, or if GPS receiver **100** is not designed to process elevation information, portable fitness device **12** can still determine elevation-dependent route and performance data regarding a route traversed by athlete **14**.

[0051] Data recorder module **226** receives route and performance information from portable training device **12** via the wireless WAN and/or local wireless interface **110** and/or data port **108** and utilizes such data to build a virtual training journal for athlete **14** within training journal database **54**. As noted previously, depending upon the operation of the upload manager **174** and route and performance recorder **176** within portable fitness device client **154**, data recorder module **226** can build a journal entry describing the traversal of a particular route in substantially

real time (i.e., during traversal of the route). Data recorder module **226** also preferably supports an interface through which a route recorded by data recorder module **226** can be exported to route database **52** for subsequent viewing, selection and scheduling within a user's training journal.

[0052] The exemplary software configuration of server computer system **42** finally includes visualization module **230**. Visualization module **230** supports one or more interfaces through which users of remote client computer systems **44** can view and/or annotate the data recorded within training journal database **54** by data recorder module **226**. In the depicted embodiment, visualization module **230** includes training journal interface **232**, which, as described in detail below, permits an athlete **14** to view and/or annotate a journal entry describing a route traversed during a fitness activity after completion of the route traversal. In a preferred embodiment, visualization module **230** further includes a real-time interface **234** through which a user at a remote client computer system **44** may view, in substantially real time, data logged within training journal database **54** for one or more athletes. Thus, for example, a spectator having access to Internet **40** can view the real-time standings of multiple competitors in a fitness activity, such as a marathon, cycling race, or other competitive event. Similarly, a remotely located trainer having access to Internet **40** via a client computer **44** can view the progress of one or more athletes **14** engaged in one or more training activities in substantially real time.

[0053] Visualization module **230** also preferably includes support for the export of selected journal entries between accounts of different users of the back-end service provided by server computer system **42**. For example, visualization module **230** preferably permits a user to transmit a journal entry representing a traversal of a route via email. In addition, visualization module **230** may permit a user to create a "buddy" account that may be accessed and even annotated by guest users. In this manner, if the services provided by server computer system **42** are provided for a subscription fee, marketing of the service is enhanced by the ability of non-subscribers or subscriber having reduced-cost subscriptions to view journal entries created by exercise partners.

[0054] Referring now to **Figures 4A-4F**, there are illustrated a sequence of graphical user interface (GUI) windows presented by route wizard **222** to a user of client computer system **44** by HTTP server **214**. As noted above, route wizard **222** provides a graphical and intuitive interface through which a remote user can automatically build, search for, and/or schedule routes to be traversed during a fitness activity.

[0055] In order to access route wizard **222**, a user stationed at a remote client computer system **44** first logs into server computer system **42** via Internet **40** and HTTP server **214**. As is well known to those skilled in the art, the login process typically includes the entry by the remote user of a login ID and password or other authentication information to server computer system **42**, which then authenticates the identity of the user by reference to the user database or the like.

[0056] Following the preliminary authentication process, an exemplary embodiment of route wizard **222** first presents a graphical user interface (GUI) window **250** to the user. Within GUI window **250**, the user is prompted to select one of three options **252**, **254** and **256**, which are each associated with a respective one of radio buttons **258a-258c**. Thus, the user is permitted to build a new route (option **252**), search for an existing route within route database **52** (option **254**), and access one or more routes within a pre-packaged training plan (option **256**). After the user has indicated a preference among options **252-256** by selecting one of radio buttons **258a-c** utilizing cursor **262** or a keyboard, the user selects Next button **260** to proceed to the next step.

[0057] If the user selected option **256** indicating that the user desires to select a pre-packaged training plan, route wizard **222** may subsequently present the user with one or more additional windows in which a training plan meeting the user's needs and desires is designed. Route wizard **222** then automatically populates the training journal of the user with a schedule of fitness activities that conform to the distance, time and/or other parameters of the training plan. Thereafter, the user may be permitted to build or search for routes within route database **52** as described below with respect to **Figures 4B-4F** in order to fulfill the requirements of the scheduled fitness activities.

[0058] Assuming that the user selects option **252** of GUI window **250** in order to build a new route, route wizard **222** next presents to the user the GUI window **270** shown in **Figure 4B**. As shown in **Figure 4B**, window **270** includes a number of GUI components prompting the user to enter parameters for the new route to be built and, optionally, desired attributes of the route.

[0059] Specifically, the user is first prompted in section **272** to designate a starting point of the route (which in this embodiment is also the ending point) by entering a street address or ZIP code or by selecting a route within route database **52** having the desired starting point. Next, the user is prompted in section **274** to enter a desired overall length of the route, specified either by distance or by time. If time is utilized to specify the length of the route, a desired or historical average pace is preferably entered so that a route distance can be computed. In addition to the route parameters collected in sections **272** and **274**, GUI window **270** may also prompt the user to enter optional route attributes. In the illustrated embodiment, the optional route attributes include a maximum distance that the route may extend from the starting point, a desired elevation profile of the route, a desired pattern of the route, a desired safety characterization of the route, a desired flow of the route, and whether or not the route may be a pre-existing route stored within route database **52**.

[0060] Once the user has entered all required parameter and any optional route attributes within GUI window **270**, the user selects Next button **280** utilizing cursor **262**. In response, route generation and publication module **220** builds one or more routes conforming as closely as possible to the route parameters and route attributes entered through GUI window **270**. The presentation of such routes by route wizard **222** is described below with respect to **Figure 4E**.

[0051] Referring now to **Figure 4C**, there is illustrated an exemplary embodiment of a GUI window **300** presented by route wizard **222** to a user of client computer system **44** is response to selection of option **254** in GUI window **250** of **Figure 4A**. That is, in response to a user input indicating that the user desires to search for a pre-existing route within route database **52**, route wizard **222** prompts the user through GUI window **300** to enter parameters and attributes of routes of interest to the user.

[0052] In the depicted embodiment, GUI window **300** includes two modalities by which the user may specify parameters for the route. In particular, in section **302**, the user is permitted to specify a location of the route by ZIP code or city name. Alternatively, as represented by button **304**, the user may specify a geographic location of the route or routes to be located by the search through a map interface. For example, if the user selects button **304** utilizing cursor **262**, route wizard **222** may present window **320** of **Figure 4D**, which is described below.

[0053] Still referring to **Figure 4C**, in section **306** of GUI window **300**, the user is permitted to input into route wizard **222** desired attributes of the route to be located through the search of route database **52**. For example, in the illustrated embodiment, the route attributes include a range of route distance, an elevation profile, a route pattern, a route safety profile, a route flow, and amenities adjacent to the route. After the user has successfully entered a route location and any desired route attributes, the user may select Next button **308** utilizing cursor **262** to invoke a search of route database **52** by route generation and publication module **220** to locate one or more routes, if any, characterized by the desired route location and any route attributes. Assuming route generation and publication module **220** locates one or more routes of interest within route database **52**, route wizard **222** presents the routes to the user through an interface such as that depicted in **Figure 4E**, which is described below.

[0054] Referring now to **Figure 4D**, there is illustrated an exemplary GUI window **320** in which route wizard **222** presents a navigable geographical map populated with graphical indications of locations for which preexisting routes are stored within the route database **52**. In the depicted embodiment, GUI window **320** includes a graphical representation **322** of a geographical area, for example, a political, cultural, or regional boundary. Within geographical representation **322**, route wizard **22** presents a number of indicia **324a-h** identifying geographic locations of one or more pre-existing routes for which route database **52** stores route data.

[0055] In response to the user flying over one of indicia **324** utilizing cursor **262**, route wizard **222** displays in a separate window or frame **330** route maps **332-336** of the routes in the

geographic location corresponding to the selected indicia **324**. Graphical representations **332-336** may be advantageously presented overlaying a street or topographical map within window **330**. If the user visually identifies one or more routes of interest at a particular geographical location through visual inspection of indicia **324** and/or the route maps **332-336** displayed within windows **330**, the user may select that geographical location by clicking on the associated indicia **324**. In this manner, GUI window **320** and its associated functionality provide the user with a graphical and intuitive way of viewing and selecting route locations of interest.

[0056] With reference now to **Figure 4E**, there is illustrated an exemplary GUI window **350** presented by route wizard **22** in order to permit a user to select from among one or more pre-existing routes that were located within route database **52** or that were built by route generation and publication module **220** in response to the input gathered by route wizard **222** within GUI window **270**. As shown, in the depicted embodiment proposed routes that may be selected by the user are presented to the user in the form of route summaries **352a-c**. Although such route summaries **352** may take any of a number of formats, in one preferred embodiment, each route summary **352** includes at least a route thumbnail **354** and a route distance **356**. The route summary **352** may further include an elevation profile **358**, which in the depicted embodiment is illustrated in graphical form, a route rating **360**, and one or more audio or textual reviews or links thereto **362**.

[0057] The user has a number of different navigation options from GUI window **350**. First, by clicking on any of route thumbnails **354**, the user is next presented with a graphical component through which the user may select or view detailed information regarding the selected route, as described further below with respect to **Figure 4F**. Alternatively, the user may utilize cursor **262** to select Next button **370** in order to view one or more additional route summaries **352** of additional routes satisfying the user's route parameters and/or route attributes. In addition, by selecting Back button **372** utilizing cursor **262**, the user is presented with one or more of the previously described GUI windows in order to permit the user to modify the route location or other route parameters or attributes.

[0058] With reference now to **Figure 4F**, there is illustrated an GUI window **380** presented by route wizard **222** to provide a detailed view of a proposed route and an interface through which the user can upload route data to portable training device **12** and schedule traversal of the route. In the illustrative embodiment, window **380** includes a detailed route map **382** indicating the geographical path of the route. Route map **382** includes terminal points **384a**, **384b** and a route path **386**. Route map **382** may optionally further include one or more annotations **388** associated with a route, which may be stored in route database **52** or accessed from map database **224**. For example, in **Figure 4F**, route diagram **382** contains an annotation **388** indicating a geographical location of a potable water source.

[0059] By clicking on route path **386** utilizing cursor **262**, the user invokes display by route wizard **222** of a marker **390a**, which may then be selectively slid to any desired location along route path **386** utilizing cursor **262**. Route wizard **222** preferably displays marker location information **392** in association with marker **390a** to indicate the geographic location of marker **390** (e.g., the distance between marker **390a** and terminal **384a** along route path **386**). In addition, route wizard **322** preferably displays a corresponding second marker **390b** in association with elevation profile **384**. In this manner, by manipulating either of markers **390a** or **390b** utilizing cursor **262**, the user can visualize the location of particular elevation features or annotations **388**.

[0060] As further shown in **Figure 4F**, window **380** further includes a rating of the route, which in this case includes between one and four "stars" and an indication of a number of reviews. In addition, window **380** may optionally include a number of written reviews, for example, displayed within text box **402**. The user may navigate to a next review of the route by selecting link **404**.

[0061] GUI window **380** of **Figure 4F** finally includes an interface through which the user may invoke the upload of route information pertaining to the route currently being viewed to portable training device **12**. In the depicted embodiment, the user can invoke upload of the route information to portable training device **12** by scheduling the route utilizing calendar interface

406. For example, in order to upload route information pertaining to the illustrated route to portable training device **12**, the user may select a desired date such as January 16, 2004, by clicking on that date within calendar interface **406** utilizing cursor **262**. In response to this input, route generation and publication module **220** enters the route to the athlete's training journal in training journal database **54** as a prospective event and uploads route information to portable training device **12** via Internet **40** and the wireless WAN. Importantly, in order to conserve data storage capacity within portable training device **12**, the upload by route generation and publication module **220** is preferably deferred until a selectable time interval of the scheduled date. In this manner, route information is provided to portable training device **12** automatically and as needed.

[0062] Referring now to **Figures 5A-C**, there are illustrated a series of GUI windows presented by training journal interface **232** of visualization module **230** of server computer system **42** to permit a user to view, annotate and share training journal entries created utilizing data received over-the-air from portable fitness device **12**. In order to access training journal interface **232**, a user stationed at a remote client computer system **44** first logs into server computer system **42** via Internet **40** and HTTP server **214**. As is well known to those skilled in the art, the login process typically includes the entry by the remote user of a login ID and password or other authentication information to server computer system **42**, which then authenticates the identity of the user by reference to the user database or the like.

[0063] Following the preliminary authentication process, training journal interface **232** of visualization module **230** presents GUI window **420** to the remote user via HTTP server **214** and Internet **40**. As illustrated, GUI window **420** includes a calendar interface **424** through which the user can select a past, current or future calendar month of interest utilizing cursor **262**. An associated list box **422** presents for selection dates within the selected calendar month having journal entries within training journal database **54** for the specified login ID. Thus, by navigating utilizing cursor **262**, the user can select for viewing journal entries detailing past or real-time routes previously traversed or currently being traversed by an athlete **14**, or prospective routes scheduled for the athlete **14**.

[0064] Assuming that the user selects a past journal entry within training journal database **54** from list box **422**, training journal interface **232** presents GUI window **440** of **Figure 5B**, again utilizing HTTP serve **214**. As shown, the journal entry presented by training journal interface **232** within GUI window **440** provides detailed information regarding a route previously traversed by athlete **14**, the athlete's performance, environmental conditions, as well as the athlete's personal comments and annotations.

[0065] In particular, the training journal entry presented within GUI window **440** includes a route map **442** having terminal points **444a-b** and a route path **446** showing the geographical path traversed by the route. As discussed above, route map **442** may advantageously be presented as an overlay of a trail or street map retrieved from map database **224**.

[0066] The overall performance of athlete **14**, in traversing the route depicted in route map **442**, is preferably summarized in a performance summary section **476**. As indicated, performance summary section **476** may indicate the route distance, total elapsed time, average pace, average heart rate of athlete **14**, as well as other route and performance information. Weather conditions at the time and geographical location at which athlete **14** traversed the route may optionally be presented in a weather condition section **478**. For example, weather condition section **478** may specify the temperature, wind speed and direction, humidity, and precipitation. The weather condition information presented within weather condition section **478** may advantageously be accessed by visualization module **230** from any of the multiple publicly accessible weather databases available via Internet **40**.

[0067] The user may interact with route map **442** in a number of ways. For example, the user may annotate route map **442** by dragging any of icons **460a-f** to a selected location along route path **446** utilizing cursor **262**. For example, in the illustrated embodiment, the user is dragging an annotation **454** representing a potable water source onto route map **442**. The user may alternatively drag callout box icon **462** onto route map **442** in order to enter a textual annotation.

[0068] In addition, in response to clicking on route path **446** utilizing cursor **262**, training journal interface **232** displays one or more markers **450a**, **452a** along route path **446**, preferably in association with one or more items of route or performance information (e.g., a distance) for the geographical location identified by the marker **450a**, **452a**. By adding markers **450a**, **452a** in this manner, the user can graphically and intuitively ascertain the geographical location of features of interest and performance and route information at selected locations along route path **446**. Training journal interface **232** may alternatively or additionally present route and performance information for a selected geographical location in response to the user causing cursor **262** to "fly over" the corresponding location on route path **446**.

[0069] In association with route map **442**, training journal interface **232** preferably presents other performance information, route information, and/or environmental information in graphical format. For example, in the depicted embodiment, training journal interface **232** presents an elevation profile **472a**, a heart rate profile **472b**, and a pace profile **472c** in association with route map **442**. When the user adds markers **450a**, **452a** to route path **446**, training journal interface **232** automatically presents corresponding markers **450b-d** and **452b-d** at corresponding locations along graphical profiles **472a-c**. As discussed above, all of markers **450** and all of markers **452** are synchronized so that movement of any of markers **450** moves all of markers **450** and movement of any of markers **452** moves all of markers **452**. In this manner, the user is able to graphically and intuitively define an interval over which performance, route and/or environmental information may be viewed. For example, in the depicted embodiment, interval information is depicted in interval section **474**, which informs the user of the interval distance, time taken by the athlete to traverse the route interval, average pace over the route interval and average heart rate over the route interval.

[0070] Of course, the particular types of route, performance and environmental information shown in **Figure 5B** are not exhaustive and other types of route, performance, and environmental information may be captured in association with the traversal of a route. If additional route, performance or environmental information is captured in association with the route, that information is preferably presented in a profile **472**, within interval section **474**, and/or within

overall performance section **476** in like manner. For example, GUI window **440** may present information regarding what pair of shoes **24** the athlete was wearing during the fitness activity, together with a lifetime mileage total for that specific pair of shoes **24**.

[0071] In a preferred embodiment of the present invention, the user may alternatively or additionally view route, performance and environmental information regarding a previously traversed route in an overlay view in which a graphical representation of the route, performance and/or environmental information is depicted along route path **446**. For example, in the illustrated embodiment, in response to user selection of overlay view button **480** utilizing cursor **262**, training journal interface **232** presents route map **500** of **Figure 5C** in place of route map **442** of Figure **5B**.

[0072] Like route map **442**, route map **500** includes terminal points **502a** and **502b** defining the starting and ending points of a route path **504**. In contrast to route map **442**, however, route path **504** of route map **500** comprises a plurality of bands **504a-c**, each of which represents a respective route, performance or environmental parameter quantified at the waypoints recorded along the route. The value of the respective route, performance or environmental parameter is preferably charted along route path **504** utilizing gray scale or color shade variation to represent the instantaneous quantity of the route, performance or environmental parameter at each point along the route. Thus, in **Figure 5C**, the different hatching applied to each of bands **504a-504c** represents a different color and a varying spacing between the hatches represents the display of the colors at varying levels of intensity along the route path, depending upon the value of the parameters at each point along the path. The value associated with each shade of color or each level of gray scale is generally graphically represented in an accompanying legend **506**. Training journal interface **232** preferably further presents instantaneous route and performance data at any point along the route path in response to a flyover of cursor **262** or in response to the user adding markers **508, 510** to the route path, as described above. For example, in association with the display of marker **508**, training journal interface **232** displays information regarding the traversed distance, relative elevation, heart rate and pace associated with a distance 1.4 miles from the beginning of the route.

[0073] Returning to **Figure 5B**, in addition to supporting user annotation of route maps **442** and **500**, GUI window **440** preferably permits the user to enter additional information regarding environmental and route conditions and personal thoughts. For example, GUI window **440** includes a route condition section **482** that permits the user to record the surface and traffic conditions observed along the route, as well as a text box **484** in which the user may enter personal reflections about the training activity.

[0074] Finally, GUI window **440** preferably includes a GUI component that permits the user to review and/or rate the route. For example, in the exemplary embodiment, GUI window **440** contains a second text box **492** in which the user can compose a review of the route and a ratings section **494** in which the user can award the route between one and four "stars". After the route has been reviewed and/or rated, the user can select Publish button **496**, which causes training journal interface **232** to store the review and rating within route database **52** in association with the route. In this manner, the review and rating are available for access by other users through route wizard **222**, as described above.

[0075] Training journal interface **232** preferably permits a user to view prospective routes that have been scheduled utilizing a similar interface to that illustrated in **Figure 5B**. In particular, in response to a user selecting a journal entry for a future date within list box **422** of **Figure 5A**, training journal interface **232** presents a journal entry containing a route map **442** of the prospective training activity as shown in **Figure 5B**. Of course, the journal entry will not contain any performance information (e.g., time, pace, heart rate, etc.) because the athlete **14** has not yet traversed the route.

[0076] Training journal interface **232** also preferably permits a user to view routes currently being traversed in substantially real time through an interface similar to that depicted in **Figure 5B**. In this case, training journal interface **232** presents a journal entry containing a route map **442** and a marker **450a** showing the athlete's current location with respect to route path **446**. In addition, training journal interface **232** may present a summary section **476** summarizing the

athlete's performance to the current position, a weather condition section **478**, an interval section **474**, and one or more graphical profiles **472**. In this manner, a remote trainer or spectator stationed at a client computer system **44** may track an athlete's performance information, route information and environmental information in substantially real time.

[0077] If a user stationed at a client computer system **44** desires to view a substantially real time view of the activities of multiple athletes traversing a common route, the user preferably logs into real-time interface **234** through HTTP server **214**. Assuming the user has the appropriate subscription and/or permissions, real-time interface **234** builds from the training journals of multiple athletes a web page containing a single route map on which multiple markers, each representing a respective athlete, are presented. The web page may further present separate performance and route information for each athlete. In this manner, a remote trainer or spectator stationed at a client computer system **44** may track performance information, route information and environmental information in substantially real time for multiple athletes traversing the same or substantially the same route.

[0078] While the invention has been particularly shown as described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention. For example, it will be appreciated that the concepts disclosed herein may be extended or modified to apply to other types of configuration entities having different rules than the particular exemplary embodiments disclosed herein. In addition, although aspects of the present invention have been described with respect to a computer system executing software that directs the functions of the present invention, it should be understood that present invention may alternatively be implemented as a program product for use with a data processing system. Programs defining the functions of the present invention can be delivered to a data processing system via a variety of signal-bearing media, which include, without limitation, non-rewritable storage media (e.g., CD-ROM), rewritable storage media (e.g., a floppy diskette or hard disk drive), and communication media, such as digital and analog networks. It should be understood, therefore, that such signal-bearing media, when carrying or encoding computer readable

instructions that direct the functions of the present invention, represent alternative embodiments of the present invention.

[0079] In addition, while the present invention has been described with respect to an exemplary software configuration in which software performing certain functions of the present invention resides on a server computer system of a service provider (e.g., of a subscription service), those skilled in the art will appreciate that, in alternative embodiments, such software may alternatively reside on a client computer system, such as client computer system **44**, and/or on portable fitness device **12**.

[0080] Furthermore, while the present invention has been described with reference to tracking and visualizing the performance and/or route of an athlete, those skilled in the art will appreciate that the present invention may also be applied to tracking and visualizing the location and movement of other persons, such as children or criminals under electronic supervision, or objects.